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Carnegie Mellon University
Software Engineering Institute

Quarterly Update

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April-June 1992

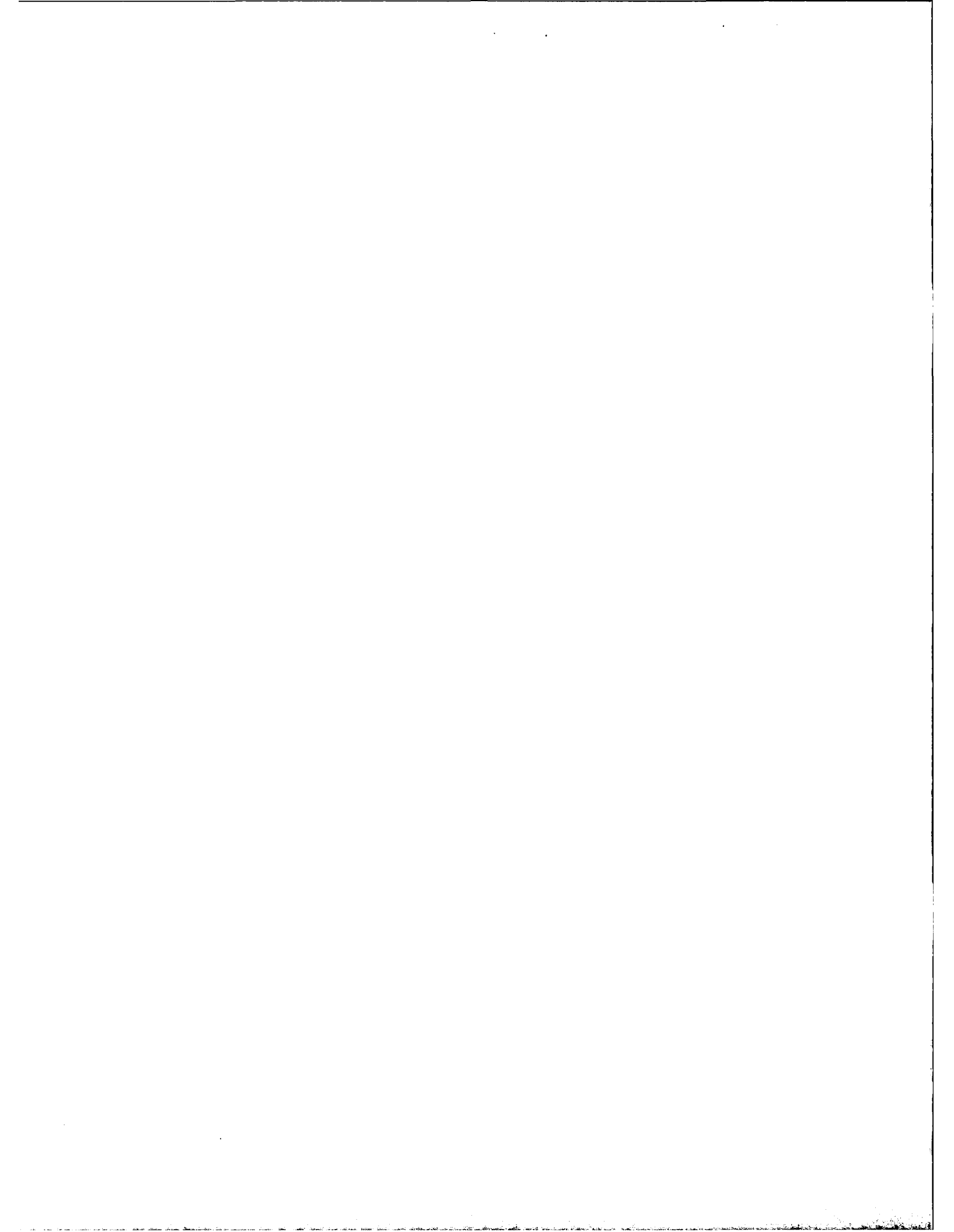
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Summary of Accomplishments: 2Q92

Software Process Measurement Project members hosted a working meeting of the Software Action Plan (SWAP) measurement team on 23-24 April.

Software Process Measurement Project members hosted a meeting on 20 May to discuss the status of the SWAP Measurement Initiative and implementation planning issues related to it.

The **Process Definition Advisory Group Workshop** was held on 1-3 April at the SEI. More than 40 members of the advisory group attended.

The **Capability Maturity Model (CMM) Project** hosted a workshop in Tysons Corner, Va., on 6-7 April. More than 200 people attended and provided feedback on the CMM V1.0 Change Request Report and the project's proposed dispositions.

A **Software Engineering Process Group Workshop**, to discuss software process improvement, was held in Tysons Corner, Va., on 8-9 April in conjunction with the CMM Workshop.

The **Empirical Methods Project** developed initial prototypes of the CMM-based Process Maturity Questionnaire and related questionnaire prototypes for use in pilot testing during 1992. Initial usability testing of the Maturity Questionnaire began in June.

Members of the **Rate Monotonic Analysis for Real-Time Systems (RMARTS) Project** have applied a tool called "TaskGen" to assess schedulability characteristics of runtime systems. A complete analysis of the experimental data has been performed, and the results are being prepared for publication.

Members of the RMARTS Project have proposed a technical associate program as a new method of interaction between the SEI and the external community.

The SEI signed technology exchange agreements with Telos and Tri-Pacific, which are the two pilot training/consulting firms for the RMARTS Project.

A paper by the **Distributed Systems Project** that was presented at the International Workshop on Configurable Distributed Systems (London) was selected for publication in a special issue of *Software Engineering Journal on Configurable Distributed Systems*.

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This section

**provides a summary
of accomplishments
from**

April—June 1992

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The Distinguished Lecture Series in Fault Tolerance—sponsored jointly by the System Fault Tolerance Project and the CMU Center for Dependable Systems—completed the series for the academic year.

The Transition Models Project presented a paper entitled “Work in Progress: A Case Study of the Transition of Rate Monotonic Analysis” at the Technology Transfer Society's 17th Annual Conference in June.

The Software Architecture Design Principles Project completed the initial presentation of a course on software architectures for undergraduate and Master of Software Engineering (MSE) students.

The CASE Environments Project gave a tutorial that synthesized the work on configuration management at the 14th International Conference on Software Engineering.

Members of the **Continuing Education Project** developed a new Continuing Education Series course for executives entitled “Software Productivity Improvement.”

The video-based practitioner course “**Software Requirements Engineering**” was completed this quarter.

The initial delivery of the **Software Capability Evaluation Overview Seminar** was conducted 3 June.

The **MSE Project** completed the taping of a revised version of Software Design, Creation, and Maintenance for the Academic Series.

This quarter, one **resident affiliate** from Lockheed Missiles and Space Company and two **resident affiliates** from Pacific Bell joined the SEI.

Table of Contents

Software Process Measurement.....	1	Software Process
Software Process Definition	2	
Capability Maturity Model	3	
Empirical Methods	4	
Rate Monotonic Analysis for Real-Time Systems.....	7	Real-Time Distributed Systems
Distributed Systems	9	
Systems Fault Tolerance	10	
Real-Time Simulators.....	11	
Transition Models.....	11	
Software Architectures Engineering	13	Software Engineering Techniques
Software Architecture Design Principles	15	
Domain Analysis	16	
Requirements Elicitation	17	
CASE Environments	17	
Binding of Ada and SQL	19	Special Projects
Process Research	19	
Technical Development	21	Software Risk Management
Operations	21	
Computer Emergency Response Team	23	SEI Services
Software Process Assessment	24	
Improvement Planning and Organizing	24	
Organization Capability Development.....	25	
Academic Education.....	27	SEI Products
Continuing Education.....	27	
Master of Software Engineering.....	28	
Software Capability Evaluation	28	
	29	Customer Relations
	31	For More Information

Software Process

The Software Process Program focuses on improving the process of software development. Projects within the program are assessing the actual practice of software engineering in the defense community, training organizations to gain management control over their software development processes, supporting the use of quantitative methods and measures as a basis for process improvement, and developing improved methods for software process management.

The Software Process Measurement Project advocates the use of measurement in managing, acquiring, and supporting software systems. The project is formulating reliable measures of the software development process and products to guide and evaluate development. To expedite Department of Defense (DoD) and industry transition, the project is actively working with professionals from industry, government, and academia in encouraging organizations to use quantitative methods to improve their software processes.

Project members met with Dr. Tim Shimeall of the Naval Postgraduate School since he was appointed the Navy interface for the project's measurement initiative in support of the DoD Software Action Plan (SWAP). Discussions focused on SWAP plans and the input needed from the Navy on the measurement efforts.

Project members hosted a working meeting of the SWAP measurement team on 23-24 April. A crucial problem involving the use of the checklists was identified and resolved and the outline for the recommendations report was refined.

This quarter, the following draft documents were released for external review:

- *Software Measurement for DoD Systems: Recommendations for Initial Implementation*
- *Software Size Measurement: A Framework for Counting Source Statements*
- *Software Effort Measurement: A Framework for Counting Staff-Hours*
- *Software Quality Measurement: A Framework for Counting Problems, Failures, and Faults*

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**Software Process
Measurement**

Project members hosted a meeting on 20 May to discuss SWAP Measurement Initiative status and implementation planning issues. Discussion topics included:

- Coordination, consolidation, and integration with other efforts
- Policy formulation, dissemination, and enforcement issues
- Release strategy for SEI documents
- Implementation Issues
- Software measurement data issues
- Training and dissemination issues
- Follow-up activities
- Funding and sponsorship open issues

A meeting was held with the Measurement Steering Committee at the SEI on 17-18 June. The focus of the meeting was to review the four draft documents in support of the SWAP measurement initiative and to discuss implementation issues.

During this quarter, two site visits were conducted in support of measurement work at Standard Systems Center (SSC), Gunter Air Force Base (AFB). The software measurement process framework was presented to the technical director, the Software Engineering Process Group (SEPG), software project managers, and other technical personnel at SSC. This generic process will be applied to integrate measurement into Process Action Team efforts. A second draft of the measurement support plan was delivered to SSC; project members are awaiting approval of the plan. Work has also been initiated to measure the benefits of the process improvement efforts of the SSC.

Five site visits were conducted in support of the Naval Air Warfare Center (NAWC) Technical Objectives and Plans (TO&P) effort this quarter. Pilot efforts have been initiated, and two special reports have been produced for NAWC: *NAWC Software Measurement Guide* and *TAMPS Software Data Collection Guide*. Project member James Rozum received a letter of commendation from William L. McCracken, Captain, U.S. Navy Commanding Officer, for his outstanding support.

The project leader participated in a Total Quality seminar at the Westinghouse Quality and Productivity Center in Pittsburgh.

Project members prepared abstracts, outlines, and presentation materials for the upcoming SEI Software Engineering Symposium.

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**Software Process
Definition**

The objectives of the Software Process Definition (SPD) Project are to establish as standard software engineering practice the use of defined processes for management and development of software and to advance the capabilities required to define the software process within an organization. The SPD Project supports process improvement through the development and maturation of methods and technology that support process definition.

The project is supporting process development efforts with SSC, Gunter AFB, and Army Materiel Command (AMC). The project is also exploring advanced applications of process through the Software Technology for Adaptable, Reliable Systems (STARS) Program.

During this period, project members supported the formation, training, and product development efforts for the Software Development Management Policy process action team at SSC. This team was chartered to develop new management policy for SSC that covers the policies and infrastructure required for an organization operating at the Repeatable Level of

the SEI Capability Maturity Model (CMM). The policy that was developed covers each of the Repeatable Level Key Process Areas. The policy defines the responsibilities for key roles within the organization, including senior management, program and project management, and a software process assurance organization (for implementing the software quality assurance function that is described in the CMM). To support this effort, the project provided consulting support to the SEPG and the process action team, conducted a one-day informal review of the principles and practices in the CMM, developed a set of guidelines for policy development that is supportive of CMM goals, and reviewed all final and interim products. Reviews were conducted by the project team, using the policy guidelines developed by the project as a standard measure of sufficiency. The feedback described where policy conformed to, exceeded, or was deficient with the guidelines in the CMM.

The project developed, reviewed, and approved a revised version of the SPD Project support plan for SSC. Due to changes in deliverables resulting from the replanning, the SSC TO&P was revised.

Project members held a product planning meeting to establish audience, purpose, and scope for the SSC lessons learned report.

Project members are providing support to the Missile Command (MICOM)/Life Cycle Software Engineering Center (LCSEC) and Armament Munitions and Chemical Command (AMCCOM)/LCSEC. During this period the project began planning support for SEPGs being formed at MICOM and AMCCOM.

Project members continued to support the planning and initiation of AMC SEPG activities. Meetings were held in conjunction with MICOM and AMCCOM. Also, project members participated in the development of the plan for the SEI AMC improvement program activities for the coming year.

The project is providing support to the Defense Advanced Research Projects Agency (DARPA)/STARS effort as technical lead for the DARPA/STARS Process Asset Library. This is a joint effort between SEI and STARS prime contractors. The effort is also supported by SEI resident affiliates from American Telephone and Telegraph (AT&T), General Telephone and Electronics (GTE), and Texas Instruments.

During this quarter, the project held a three-day workshop for the advisory group that is providing guidance and support for the STARS effort.

The Process Definition Advisory Group Workshop was held on 1-3 April at the SEI. More than 40 members of the advisory group attended. The meeting covered an overview of fundamental concepts and a discussion of future products.

The Capability Maturity Model (CMM) Project maintains a model describing how organizations can improve their software process maturity. This model will be continuously updated with the state of the art as it evolves in software engineering, total quality management, and other relevant areas of improvement. It will elaborate on software development practices that provide clear strategies for capability maturity growth and improvement.

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**Capability
Maturity Model**

The CMM Project hosted a workshop in Tysons Corner, Virginia, on 6-7 April. More than 200 people attended and provided feedback on the CMM V1.0 Change Request Report and the project's proposed dispositions. As a result of the workshop, the CMM revision team was established, and work began on revising CMM V1.0 based on change requests and workshop feedback.

The project leader continued to participate in the International Standards Organization's JTC1/SC7 work on software engineering standards. A new working group has been formed based on the recommendations from a Process Management Study Group that was established in 1991. This working group, SC7/WG10 – Software Process Assessment, will prepare a series of standards in the area of evaluation and assessment of processes in the software life cycle.

A project member is working on an "instant profiling" method based on the CMM with the Empirical Methods and CMM Projects. Requirements for this effort were explored by an industry working group that met at Texas Instruments on 18 May. A need for a range of assessment and evaluation methods was identified and is under development with SEI collaboration.

An SEPG Workshop to discuss software process improvement was held in Tysons Corner, Virginia, on 8-9 April in conjunction with the CMM Workshop.

CMM project members gave presentations and briefings at the Total Quality Management (TQM) for Software Conference in Washington, D.C. on 29 April, and at the Defense Science Management College (DSMC) on 2 June. Also, tutorials were given after the SEPG Workshop on 10 April, and at the Pacific Northwest Quality Conference Workshop on 18 May in Portland, Oregon.

During this quarter, CMM project members participated in meetings with visitors from PacBell, Texas Instruments, Rockwell, GTE, Hughes, Microelectronics Computer Technology Corporation (MCC), and European Strategic Programme of Research into Information (ESPRIT)/ATMOSPHERE on CMM-related activities.

A CMM project member participated in the Software Engineering Capability Improvement Working Group to address software process assessment (SPA)/software capability evaluation (SCE) differences in scoring.

The project leader participated in meetings of the Harmonization Working Group, which is revising DOD-STD-2167A in conjunction with DOD-STD-7935A.

The project leader also attended the DARPA Principal Investigators Workshop on Software Process Management in Los Angeles, California.

• • • • • Empirical Methods • • • • •

The Empirical Methods Project develops, evaluates, and validates products—questionnaires and tests, methods, and models—for use in baselining and measuring software process improvement.

Initial prototypes of the CMM-based Process Maturity Questionnaire and related questionnaire prototypes were developed for use in pilot testing during 1992. Initial usability testing of the Maturity Questionnaire began in June. The SEI team will test questionnaire prototypes in several industry and government organizations to improve the clarity and useability of the updated Process Maturity Questionnaire.

An SEI team, led by Empirical Methods, is also developing questionnaires for use in capturing consistent information to determine the scope of SPAs and SCEs, help with selecting projects to include in a SPA/SCE, and to collect information about those completing the Maturity Questionnaire for use in efficient planning of the on-site period for software process assessments and software capability evaluations.

The Empirical Methods and CMM Projects are working with a resident affiliate from Pacific Bell to prototype an "instant profile" product. This diagnostic approach was one of several discussed during a birds-of-a-feather session at the CMM/SEPG Workshop held in Tysons Corner, Virginia, in April. Exploration of joint product development work with industry and government members of the process improvement community began in February and is ongoing.

Real-Time Distributed Systems

The goal of the Real-Time Systems Program is to improve the development of real-time distributed systems by integrating software engineering with systems engineering and reducing the risk associated with new technology.

The Rate Monotonic Analysis for Real-Time Systems (RMARTS) Project aims to ensure that rate monotonic analysis (RMA) and scheduling algorithms become part of the standard practice for designing, building, troubleshooting, and maintaining real-time systems. RMA helps engineers to understand and predict the timing behavior of hard real-time systems to a degree not previously possible.

Project members are working with the Navy Next Generation Computer Resource (NGCR) Program to encourage the development of standards that meet real-time developer needs. A report was recently completed that addresses schedulability considerations in implementations of interfaces for local area networks. This report includes a set of questions that may be applied to an implementation to develop an integrated schedulability model of the application as well as the interface implementation.

Project members are continuing to work with the POSIX.12 group that is developing a protocol-independent interface for interprocessor communication. The project has taken the lead in the development of the real-time extensions to POSIX.12 and is working to assure that the resulting specification will meet the schedulability needs of real-time developers. The first meeting of the group responsible for the real-time extensions will take place in July.

Project members continue to serve as customers for a studio project in the Masters of Software Engineering (MSE) Program at Carnegie Mellon University (CMU). To date, the requirements documents have been signed off for a real-time analysis toolset, and the students are now beginning the tool design. The purpose of the tool is to be able to develop a schedulability analysis that includes the effect of the runtime system in a portable manner; that is, the tool may be used to model different runtime systems in a generic manner. Another MSE student from Raytheon has completed an independent study course in RMA.

Project members have applied a tool called "TaskGen" to assess schedulability characteristics of runtime systems. TaskGen allows one to create— at runtime—an arbitrary set of periodic tasks. Using this tool, project members have discovered an apparent anomaly. For a single task, if one plots the maximum achievable load (the load at which deadlines are met) as a function of task frequency, there are discontinuities in the plot. Project members have been able to explain this behavior: the existence of the discontinuities is traced to the granularity of the workload unit. In the present case, the workload unit is the kilowhetstone, which is used in the Hartstone experiments. A complete analysis of the experimental data has been performed, and the results are being prepared for publication.

Project members have proposed a technical associate program as a new method of interaction between the SEI and the external community. The program is based on a formal interaction with clients who need not be in residence at the SEI. The program has been approved by the SEI, and its implementation is now being developed.

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**Rate Monotonic
Analysis for
Real-Time
Systems**

Project members continued working toward the long-range goal of producing a Real-Time Systems Engineering Handbook. The goal of the handbook is to codify the principles of RMA in a manner that is easily accessible to real-time systems practitioners. Work on the handbook has evolved through a series of drafts, each with a special focus or theme. The focus of the first draft was usability. During the first quarter of 1992, project members developed a prototype of the handbook and tested it by watching users try to solve problems while using the prototype. Much of what has been learned while testing the first version of the handbook has been implemented in the second version of the handbook. In producing this version, project members focused on restructuring it into its final form so that individuals other than the primary authors may contribute to it. The core of the handbook is a structured collection of real-time situations. A real-time situation is a small, self-contained module of information about rate monotonic analysis. For this version, project members:

- Defined the structure of a real-time situation.
- Revised the framework for describing real-time situations.
- Wrote numerous techniques (techniques are the mathematical basis for analyzing timing behavior).
- Added a section that describes the fundamentals of rate monotonic analysis.

This second version of the handbook, which reflects these changes, has been sent to potential external contributors to the handbook.

Project members have begun working on the third version of the handbook. The focus of this version is the development of realistic case studies. There are two case studies; one that shows how to use RMA to analyze a realistic real-time system, and one that demonstrates the use of the principles of RMA to guide the design of a real-time system. The case studies are important for the handbook since they illustrate how to apply RMA knowledge contained in the rest of the handbook to realistically complex systems.

The RMARTS Project has been assisting the BSY-2 contractor in applying RMA to the BSY-2 software. Recent work concentrated on the nuclear partition computer software configuration items. During this quarter, however, the BSY-2 prime contractor announced a work stoppage on all nuclear partition software. Further efforts have been suspended pending notification from the prime contractor. In the meantime, work continues in preparing the RMA handbook for use on the BSY-2 project.

The SEI signed technology exchange agreements with Telos and Tri-Pacific, which are the two pilot training/consulting firms for the RMARTS Project. Both Telos and Tri-Pacific began developing RMA courses to offer to their clients. Each conducted internal courses as dry runs and as an opportunity to transition the technology to other employees. Both companies are preparing to advertise their offering of RMA courses, and both will be represented at the SEI Software Engineering Symposium in August, where each will have a vendor booth and where their RMA courses will be included in the SEI products portfolio.

At the Software Technology Support Center conference, project members gave a presentation on RMA management practices. This presentation has been expanded for a half-day tutorial at the Washington Ada Symposium (WAdaS). Project members also began interacting with organizations involved in independent validation and verification as possible transition agents for the RMA management practices.

Project members worked with representatives of the Naval Warfare Center-Weapons Division, at China Lake, to develop a new version of the RMA tutorial. This new tutorial has been established as the RMARTS baseline course material and has been given to Telos and

Tri-Pacific, as well as to groups that are involved in the transition of RMA to their organizations. A full-day RMA tutorial will be presented by Naval Warfare Center staff at WAdaS and Tri-Ada '92.

This quarter, project members have been working with the University of Colorado to develop videotaped curriculum modules on RMA. Project members have also met with representatives of the Software Productivity Consortium (SPC). The SPC is working on the Ada-based design approach for real-time systems (ADARTS) software design method, and they hope to incorporate RMA into ADARTS to enhance system performance analysis in the ADARTS method.

The project began planning an RMA users forum, which will be held in conjunction with the SEI Software Engineering Symposium. This event will take place on the Friday following the symposium. It will include organizations using RMA in development and vendors supporting it in their products. The project plans for presentations and discussion on user experience with RMA, management and adoption issues, vendor and system support, and future work on RMA.

The Distributed Systems Project (formerly the Software for Heterogeneous Machines Project) is developing tools and a methodology for building distributed, large-grained, concurrent applications to run on networks of heterogeneous machines. The project has developed Durra, a language for describing distributed applications as a set of task descriptions and port connections. The Durra compiler generates Ada program units that link clusters of application tasks as executable programs. A library package provides application/location independent communication facilities to the application tasks.

Project members were invited to give a talk and a demonstration of the Durra language and tools to both Programmable Reusable Integrated Software Modules (PRISM) contractors, Hughes Aircraft, and Raytheon.

A paper by Mario Barbacci, Dennis Doubleday, and Chuck Weinstock that was presented at the International Workshop on Configurable Distributed Systems (London) was selected for publication in a special issue of *Software Engineering Journal on Configurable Distributed Systems*.

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Distributed Systems

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**Systems Fault
Tolerance**

The Systems Fault Tolerance Project is investigating the use of fault tolerance in the design and implementation of dependable or critical systems.

The System Fault Tolerance Project has been invited to participate in an initiative for a National Center for Dependable Systems, coordinated by the Aerospace Corporation. The National Center is to be a federation of key workers in the field of fault tolerance and reliability. The initiative is characterized as "a national team approach to develop the necessary and sufficient requirements, methodologies, and tools and techniques to cost effectively design and evaluate dependable systems." As part of this effort, the System Fault Tolerance Project has joined the Dependability Working Group (DWG), an advisory group drawn from industry, university researchers, and government personnel. A project member attended the spring DWG meeting at Martin Marietta in Denver, Colorado. Project members are also involved in an effort sponsored by the DWG to implement a nationwide on-line database for dependability technology.

A project member served on the Real-Time/Fault Tolerance Technology Panel for the DoD Software Technology Strategy Public Forum on 31 March–2 April in Tysons Corners, Virginia. The technical content of the Real-Time/Fault Tolerance chapter of the Technology Strategy was generally well accepted — many of the comments from the forum attendees were aimed at increasing the emphasis on portions of the chapter.

This quarter, project members and members of the CMU Electrical and Computer Engineering Department and the CMU School of Computer Science collaborated to make additions to the operating system in the Fault Tolerant Mach research effort. In the last few months, minimally intrusive mechanisms called *sentries* have been added to monitor the entry and exit points for most of the commonly used UNIX services that are accessed via the Mach kernel. When activated, these sentries can passively monitor the flow of information to and from UNIX services to detect faults and aid in fault diagnosis. Sentries can also perform an active role by changing the flow of control to compensate for faults.

The group also implemented and tested a library of logging sentries that store information about system call activity to stable storage. Technology from the CMU PIE program was used to build a graphical display and analysis tool capable of reading logging sentry entries while a test program is running, or after completion of test program execution. The resulting system was used to monitor the activity of a commercial UNIX operating system under stress from a program that subjects the operating system to a barrage of random calls passing random data. The system was used to identify parameters that could unconditionally crash a particular UNIX service, and a simple sentry to detect these parameters and prevent a system crash by aborting the system call was demonstrated.

The Distinguished Lecture Series in Fault Tolerance—sponsored jointly by the System Fault Tolerance Project and the CMU Center for Dependable Systems—completed the series for the academic year with a lecture entitled "Fault Tolerance in Real-Time Systems" by Dr. Ashok Agrawala of the University of Maryland. This quarter, Dr. Rick Schlichting of the University of Arizona also presented a lecture entitled "A Communications Substrate for Fault Tolerant Distributed Programs."

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Real-Time Simulators

Real-time simulators, especially flight simulators, have traditionally used a software architecture optimized for efficiency. The focus on efficiency has caused serious problems in achieving certain types of functionality and has caused severe problems in maintainability and modifiability. Understanding the design tradeoffs involved in emphasizing particular non-functional qualities will enable model software architectures to be developed that satisfy the design qualities and this, in turn, will greatly assist the process of developing real-time simulators.

The goals of the project are:

- Extend, validate, and document flight simulator and other real-time simulator architectures in a form accessible to practitioners and acquisition personnel.
- Understand and codify the relationship between non-functional quality goals and simulator software architectures.

This quarter, project members completed a paper entitled "Introduction to Structural Models" for the Air Force Aeronautical Systems Division Program Office for Simulators and Trainers. This paper describes structural models in general terms and a particular structural model appropriate for flight simulators.

The project has also provided software architectural design support for the Special Operations Forces Aircrew Training System prime contractor, Loral, and several different subcontractors.

The project has begun scoping and organizing a guidebook for the flight simulator structural model. A document that gives the scope of the initial version of the guidebook has been written and is currently under review.

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Transition Models

The Transition Models Project is developing a set of methods and supporting materials such as guidelines and checklists for planning, implementing, and assessing transition activities. These materials will be used by software technology producers and consumers both inside and outside the SEI. Transition Models staff also provides other SEI staff, including management, with education and training on technology transition concepts and approaches. Additionally, project members provide limited consulting on software technology transition to members of the SEI constituencies, and maintain contact with researchers and others interested in technology transition from business and academic domains.

The project leader presented a paper entitled, "Work in Progress: A Case Study of the Transition of Rate Monotonic Analysis" at the Technology Transfer Society's 17th Annual Conference, 24-26 June, in Atlanta, Georgia. Another Transition Models project member is the coauthor and also attended the conference. The project leader presented an earlier version of this case study at the DARPA Software Technology Conference in Los Angeles, California, on 30 April-2 May, 1992, and at the Second Technology Transfer Symposium of the Council of Consortia on 2 April in Austin, Texas.

Staff members of Transition Models, and Products and Services Planning attended the Second Technology Transfer Symposium, 1-3 April, hosted by MCC in Austin, Texas. This trip included visits to the University of Texas at Austin to discuss research in technology transfer. A visit to Sematech was also made to discuss the status of their software improvement work with equipment suppliers.

During this quarter, project members attended the Entrepreneurial Technology Transfer conference, sponsored by the Massachusetts Institute of Technology Enterprise Forum, on 18-20 May in San Francisco, California. The conference tutorials and sessions addressed managing innovation, how to succeed as a high technology start-up organization, technology licensing issues in government and university settings, how the venture capital industry is evolving, and incubators for small start-up companies. On 10 June, the project leader presented a short tutorial on software technology transition to the students in the CMU MSE program as part of their seminar on software engineering.

Transition Models project members continued work to confirm its draft conceptual framework for software technology transition. In parallel, work to document software technology implementation processes in detail has begun.

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**Real-Time
Distributed
Systems Reports**

April—June 1992

Ada Validation Tests for Rate Monotonic Scheduling Algorithms
(CMU/SEI-92-TR-1)

*Parallels in Computer-Aided Design Framework and Software Development
Environment Efforts*
(CMU/SEI-92-TR-9)

For information about ordering copies of SEI reports, see page 31.

Software Engineering Techniques

The goal of the Engineering Techniques Program is to increase precedented engineering for effective and efficient production of large software-intensive systems through a model-based engineering approach and engineered project support environments.

The Software Engineering Techniques Program recently reorganized to integrate SEI technical work with a common technical vision and strategy. The CASE Technology Project and the Software Development Environments Project were consolidated into the CASE Environments Project. (Project work for the consolidated CASE Environments Project is presented below.) The Domain Analysis Project and the Software Architectures Engineering Project were consolidated into the Application of Software Models Project. The Advanced Video Technology for Imaging Project, the Requirements Engineering Project, and the Software Architecture Design Principles Project were consolidated into the Software Engineering Modeling Project. Coverage for these two consolidated projects will begin with the next Quarterly Update.

The Software Architectures Engineering (SAE) Project has been involved in the engineering of software in several critical DoD application areas for the last six years. The project's goal is to use sets of identified patterns with engineering design goals in providing guidelines for building the basic elements of software structure (models). The project is currently focusing on three aspects of this technology:

- The generalization of software models by providing templated structural elements and connection rules that invest the implemented software with the desired product qualities.
- The naturalization of the models so that real-world components have corresponding software analogs.
- The application of tools and notations to software development based on generalized structures. The project calls this technology model-based software development (MBSD).

The SAE Project provides DoD program offices with improvements to the practice of software engineering by assisting in the creation and adoption of model-based technology. Project members accomplish these improvements by helping clients to abstract the desirable software architecture characteristics for particular classes of applications and to use them in creating reusable patterns of software structures specific to an application. Project members refine and mature the new models by transferring them to other projects, which provides additional sources of feedback on their use.

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**Software Architectures
Engineering**

During this quarter the SAE Project had two tutorials and a technical paper accepted to three upcoming conferences. The paper, entitled "Modeling Software Systems by Domains," was accepted by the Automating Software Design workshop. This workshop will be held in conjunction with the AAAI-92 Conference in July. One of the tutorials will be presented at Tri-Ada '92 in November. This is a joint tutorial with Sholom Cohen of the SEI. The other tutorial, "Putting the 'Engineering' into Software Engineering," was accepted for presentation at the Sixth SEI Conference on Software Engineering Education in October. This will be the only tutorial presented during this conference.

The SAE Project has been working closely with the Transition Models (TM) Project on refining transition models for commercialization of MBSD. As part of this collaboration, the SAE and TM projects held an MBSD off-site in May. The off-site explored a vision for the state of the world given the institutionalization of MBSD.

The SAE Project has been working with the Air Force Electronic Combat Office and the Tri-Service CROSSBOW-S organization on the Joint Modeling And Simulation System (J-MASS). J-MASS currently relies on the SAE Project's model-based software development concepts and the Object-Connection Update (OCU) architectural model as the basis for simulation models used within the system. During the second quarter, work continued in several areas. For application executives, project members continued participation with J-MASS contributors on the design of new executives for the J-MASS system, which will allow either real-time or non-real-time operation in a distributed environment. Project members are also exploring the integration of the OCU and object database systems. A major focus of the J-MASS Project is a system composition tool, which will allow for easy assembly of simulation systems. Project members continued work on the role of the OCU as an aid to composition, and the role of composition rules in the composition process.

The SAE Project has been collaborating since the summer of 1991 with Major Paul Bailor and Dr. Thomas Hartum of the Air Force Institute of Technology. During this quarter, Major Bailor visited the SEI for an intense two-day technical interchange and stayed for another day to participate in the joint SAE/TM vision off-site. The SAE Project has invited Major Bailor to be a visiting scientist at the SEI this summer.

SAE Project members continue to work with the Coastal Systems Station (formerly Naval Coastal Systems Center). The work is performed via the Combat System Integrated Training Equipment (CSITE) Architecture Working Group (AWG). SAE members provide expertise based on five years of experience in engineering software systems. The CSITE AWG is the vehicle for transitioning SAE modeling and model-based development expertise. The charter for the CSITE AWG is to define and evolve the CSITE structural model, the CSITE application design, and the software development plan. SAE members attended two AWG meetings in June. The project produced a draft revision to the existing TO&P based on input from the CSITE program manager.

During this quarter, SAE developed the documentation of the CSITE product models. These models will help populate the SAE public MBSD technology base. SAE project members also spent some time thinking about a general application design and the models to support it. The major focus of the design is on application level issues.

Project members are working with the DARPA Domain-Specific Software Architecture (DSSA) Program. DARPA is funding several industrial and academic teams to focus on software architecture development in DoD-critical domains. The SAE Project is participating in efforts to define software architectures for control in factory automation and manufacturing systems. The results will be generally applicable to all teams in the DSSA Program.

In conjunction with SEMATECH, the SAE Project is writing part of a proposal to participate in engineering modeling work for software-dependent control systems in the Corporate Integrated Manufacturing application area. SAE project members are currently writing a white paper describing future factory control systems at machine, cell, and factory floor levels.

SAE project members attended the second Advanced Equipment Control workshop, sponsored by SEMATECH, held in Mesa, Arizona. The workshop was useful in verifying many of the factors included in the white paper. SAE members attended a three-day workshop entitled "World Class Manufacturing Systems Engineering" presented by Dr. John Manley, Director of the University of Pittsburgh Manufacturing Systems Engineering Program. SAE members attended an Automation Open House at the National Institute of Standards and Technology (NIST) hosted by the Automated Manufacturing Research Facility. The open house focused on advanced technologies to strengthen manufacturing sectors.

SAE project members have received several requests for information on the Message Translation and Validation (MTV) model solution, which was created in 1988. The requests have come from members of the DARPA DSSA community, industrial independent research and development groups, other federally funded research and development centers, the Naval Academy, and several DoD software efforts. SAE is reviewing the requests and is considering refining the MTV model so it can be integrated into the control system technology base that SAE is evolving.

To develop a fundamental understanding of structures for the software architecture level of design, the Software Architecture Design Principles Project is describing basic design elements used in the description, analysis, and development of software systems.

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**Software Architecture
Design Principles**

This quarter, the project enhanced the UniCon system by improving robustness, adding error checking, revising syntax, installing support for module instantiations, and extending pipe support to allow file connections. The project also began a prototype of the graphical user interface.

The initial presentation of a course on software architectures for undergraduate and MSE students was completed. A paper based on this course, "Experience with a Course on Architectures for Software Systems," has been accepted for the SEI Software Engineering Education Workshop, which will take place in the fall.

The project leader presented a panel at the International Conference on Computer Languages, and the paper "Tyrannical Languages *Still* Preempt System Design" appeared in the proceedings. The project leader also gave a presentation at Stanford this quarter on software architecture.

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Domain Analysis

The Domain Analysis Project is currently working with several Army projects to use the movement control domain analysis in the implementation of movement control applications. The analysis, completed last year, produced a domain model of Army movement control, establishing commonality among movement control applications and representations to support exploiting that commonality. The project used the Feature-Oriented Domain Analysis (FODA) method, developed by the project in 1990, in performing this analysis. The domain analysis provided a model of applications within the domain that has been used to understand the design of those applications and to support the development of new movement control software.

The project has been working together with staff from the Information Systems Engineering Command Development Center at Ft. Lee (DCL) to integrate a slice of the Highway Operations System under development by Development Center, Ft. Lee. The SEI has written a reusable convoy package and DCL packages to support database operations and table management. Project members successfully integrated convoy and vehicle table subsystems into a working slice. Project members have also worked out a skeletal executive program and user interface subsystem. Using Object Connection Update (OCU) structural modeling, project members were able to achieve consistency in control, packaging, and data flow. In addition, progress has been made in several patterns of operation that should recur throughout the application: data verification and auto-save operations. The project is also coordinating support to the Army from the Requirements Engineering Project for use of the domain model as a basis for requirements analysis.

The project is currently planning for use of the movement control domain analysis and software throughout the Army Tactical Command and Control System (ATCCS). The transition of the software will require rehosting of the Highway Operations System, currently under development by the Software Development Center at Ft. Lee, to the ATCCS common hardware and software. A resident affiliate from the Army Communications and Electronics Command (CECOM) will be participating in this effort this year. During 1993, project members will work with project managers and developers within ATCCS to transition movement control as a common ATCCS application.

In March, the project hosted a visit from the Research, Development, Test, and Evaluation Division (formerly the Naval Ocean Systems Center) and the Air Force Central Archive for Reusable Defense Software (CARDS) Project. The project leader presented the domain analysis tutorial, and visitors saw demonstrations of CARDS and 001, a software modeling and composition tool. CARDS requested a follow-up meeting at the Electronic Systems Division (ESD).

A project member completed initial implementation of the prototyping tool and has started testing of the final subsystem. The prototype will next be enhanced to illustrate graphical representation of schedules and tables.

Project members met with members of the SEI Technology and Program Development Divisions to discuss connections with PRISM and North American Air Defense Command U.S. Space Command Integrated Command and Control Center (NUICCS), a Cheyenne Mountain project. An Air Force resident affiliate provided the group with background information and agreed to provide detailed information so that an Institute-wide response to ESD and NUICCS needs can be formulated.

This quarter, the project hosted a half-day meeting with the GTE DSSA Project. Attendees from GTE, CECOM, and George Mason University agreed on the underlying concepts of domain analysis, architecture development, and reuse implementation strategies.

Project members presented the domain analysis tutorial to CARDS in West Virginia. The CARDS representatives found the modeling ideas applicable to their use of the reusability library framework as a modeling tool.

Project members presented ESD with an update on SEI core projects related to Aviation Systems Command activities. The project also presented results of the domain analysis tasks to the DoD Corporate Information Management (CIM) Reuse Technology Working Group.

The Requirements Elicitation Project is investigating the methods, tools, and processes necessary for the capture, analysis, and validation of requirements for software-intensive systems.

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**Requirements
Elicitation**

The project acquired a prototyping tool, Proto, from Rome Laboratory, and has been testing the tool for use in this project. The project also plans to acquire the Storyboard prototyping technique from the Naval Air Development Center.

The project reviewed the requirements document of the Army Highway Operations System for Army CASCOT and identified areas that can be improved. The project is also working with Army CASCOT to capture requirements and reproduce requirements documents.

The CASE portion of the CASE Environments Project focuses on improving the ability of SEI sponsors and affiliates to make informed decisions about tool adoption and improving their practice in the use of CASE tools. It also provides information to tool vendors on current tool usage and gaps in current technology.

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CASE Environments

The environments portion of the CASE Environments Project focuses on environment support for software configuration management (SCM) and environment architectures in support of integration.

The CASE Technology Project has three major task areas:

- Environment support for configuration management
- Environment support for integration
- CASE adoption

The project has identified the state of commercial technology regarding SCM support. This has been captured through a spectrum of concepts and four observed paradigms. Configuration management (CM) capabilities can be found in SCM tools, CASE tools, and environment frameworks, each implementing its own variant of some of the concepts. This variety leads to the need to integrate tools with different SCM capabilities into a software development environment, and the desire for a unified SCM model that can be adapted to different processes. The result is project activity in issues of consolidation of SCM concepts, integration of SCM and CASE tools, and SCM support for the CM process and its relationship to the CMM. During the past quarter, a project member gave a tutorial that synthesized the work on configuration management at the International Conference on Software Engineering.

The need for integration of SCM and CASE and a number of emerging environment technologies has led to increased project activity on environment architectures in support of integration. A number of government and industry efforts are focused on environment reference models and interface standardization. New insights are gained into the problem of environment integration, taking into consideration environment framework mechanisms, engineering service concepts and information models, and engineering processes.

In the SCM area, the results are communicated through articles, presentations, and tutorials. In particular, a paper describing aspects of project work on understanding the state of the art in SCM has been accepted for the International Federation of Information Processing World Congress. The paper, "The Past, Present, and Future of SCM," will be presented at the conference, which will be held this September in Madrid. Another paper, "Parallels in Computer-Aided Design Framework and Software Development Environment Efforts," was presented at the Electronic Computer-Aided Design Conference in Germany in March.

The project has continued its development of a conceptual framework for helping to understand, compare, and analyze environment integration. This work is performed in the context of providing technical leadership in the Navy's NGCR work within their Project Support Environment Standards Working Group, as well as participation in the National Institute for Standards and Technology Integrated Software Engineering Environments forum. In addition to direct contributions to these efforts, the conceptual framework and its application are described in detail in two SEI technical reports: *The Conceptual Basis for a Project Support Environment Services Reference Model* and *An Analysis Technique for Examining Integration in a Project Support Environment*. Aspects of this work have been summarized in two works: "Understanding Integration in a Software Development Environment," which was presented at the International Conference on Systems Integration in June; and "Past and Future Models of CASE Integration," which will be presented at the CASE '92 Conference in Montreal, Canada, in July. Project members also provided working group leadership at the Software Engineering Tools for Ada Conference on the topics of environment integration and process support through user interfaces.



Software Engineering Techniques Reports

April—June 1992

Understanding Integration in a Software Development Environment
(CMU/SEI-91-TR-31)

Requirements Engineering and Analysis Workshop Proceedings
(CMU/SEI-91-TR-30)

The Conceptual Basis for a Project Support Environment Services Reference Model
(CMU/SEI-92-TR-2)

An Analysis Technique for Examining Integration in a Project Support Environment
(CMU/SEI-92-TR-3)

Issues and Techniques of CASE Integration with Configuration Management
(CMU/SEI-92-TR-5)

For information about ordering copies of SEI reports, see page 31.

Special Projects

The Binding of Ada and SQL Project, initiated at the request of the Ada Joint Program Office, has investigated the problem of binding the Ada programming language with the Structured Query Language (SQL) database language. The solution to this problem was the specification of the SQL Ada Module Extension (SAME), an interface that permits an application program written in Ada to access and manipulate data that is controlled by a database management system (DBMS) using SQL.

During this quarter, the latest revision of the *SAMeDL Reference Manual (Intermediate Version 4)* was mailed to all members of Working Group 9 (WG9).

In May, the project leader attended a meeting of the U.S. Technical Advisory Group on Ada (USTAG) in Boston. The USTAG voted to support motions to advance the *SAMeDL Reference Manual* through the ISO (International Standard Organization) standardization process.

The project leader also attended meetings of the SQL Rapporteur Group (SRG) WG9 in June. The SRG unanimously approved a resolution, which requested that WG9 approve a motion to approve the *SAMeDL Reference Manual*. At its meeting, WG9 unanimously approved that motion. This begins a by-nation ballot process that will elevate the manual to the status of Draft International Standard. The SRG requested a few changes in the reference manual and in the language rationale, which is not itself a potential standard.

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**Binding of Ada
and SQL**

The Process Research study will investigate factors that limit software development performance by conducting research on how software process principles are applied to individuals and small teams. This research, in turn, will provide further insight into the processes, tools, and methods that will be the most useful to software professionals.

During this quarter, work was completed with several students in the CMU MSE Program to introduce and use some of the methods being developed in the Process Research study. Two students developed a timing tool, and one student applied the methods and measured the results for five test programs.

A total of 23 programs using the C++ programming language with the Personal Software Process (PSP) were completed. The PSP is the principal focus of the Process Research study. This work to date has been incorporated in a draft document that is available to interested researchers in the field for comment.

The leader of the study gave the keynote address at the Sixth Israel Conference on Computer Systems and Software Engineering and chaired a panel at the Fourth International Conference on Strategic Software Systems.

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Process Research

Software Risk Management

The Risk Program is exploring existing techniques and developing methods for managing risk, assessing practice, preparing organizations to manage risk, and conducting prototype risk assessment methods. To achieve its goal and objectives, the Risk Program must not only provide the mechanisms for managing risks, but must also provide a process that can be implemented within a project and organization and that can facilitate the communication of risk issues. Communicating risk underlies the strategy of addressing risk throughout the acquisition process, with specific attention to developing risk-driven acquisition strategies and systematic risk reviews.

The Technical Development Area provides mechanisms, methods, and tools for risk management. Project members have developed a risk paradigm as an approach to risk management and are exploring both existing technology and new methods to identify, analyze, plan, track, control, and communicate risk to improve risk management within the defense community.

Work in the Technical Development Area has focused on risk analysis and education. In the risk analysis arena, project members have continued preparing the Comparison Risk Ranking method for field test.

During this quarter, the Software Risk Management Course design was developed and reviewed by the Education and Training Review Board.

An article for *American Programmer* on software risk management was drafted and reviewed.

The draft Risk Program white paper has completed review by the program and Information Management and was submitted to the Joint Program Office for approval.

A project member presented a paper at the Fourth Symposium on Quality Function Deployment about the program's use of methods that are similar to the Quality Function Deployment method for risk identification.

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**Technical
Development**

The Operations Area provides the primary interface to customers and conducts interviews and risk assessments as test vehicles for developing risk management methods. It develops and conducts interviews, risk assessments, risk assessment training, and risk profiles. Risk management methods are improved through active field work with government and industry defense programs. The Operations Area will develop methods to facilitate and strengthen risk communication through a rational, visible structure for identifying and analyzing risk. This area is concerned with creating viable methods for communicating risks internally within projects and externally to higher levels of management.

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Operations

During this quarter, project members continued to test the risk management methods with industry. Specifically, project members:

- Conducted the probe for Risk Assessment #3. The areas probed were system integration and simulation modeling.
- Conducted a special training session on risk assessments for SEI members of the technical staff and for ISX, a DARPA contractor on the Dynamic Analysis and Replanning Tool Program.
- Held Field Test #4 on the Taxonomy Risk Identification Mechanism.
- Negotiated client commitments for Field Tests #5-7 for the third quarter of 1992.

A key part of the project's government focus is the use of risk management principles in the acquisition process. Project members are continuing the work on risk-driven acquisition strategies for government program managers.

Planning for the COCOMO users' group meeting also continues. It will be held at the SEI in November.

Planning for the next Software Risk Management Conference, to be held in March 1993, continues. The program committee has been selected and has met for the first time.

SEI Services

SEI Services works with other groups in the SEI to develop, deliver, and transition services that support the efforts of SEI clients to improve their ability to define, develop, maintain, and operate software-intensive systems. To accelerate the widespread adoption of effective software practices, SEI Services works with client organizations that are influential leaders in the software community, promotes the development of infrastructures that support the adoption of improved practices, and transitions capabilities to government and commercial associates for use with their client organizations.

The Computer Emergency Response Team (CERT) was formed by DARPA in November 1988 in response to the needs exhibited during the Internet worm incident. The CERT charter is to work with the Internet community to facilitate its response to computer security events involving Internet hosts, to take proactive steps to raise the community's awareness of computer security issues, and to conduct research targeted at improving the security of existing systems.

To facilitate the community's participation in developing methods, tools, and techniques to prevent or deal with computer security incidents, CERT staff are organizing two major conferences. The Fourth Workshop on Computer Security Incident Handling will be held in Denver on 4-7 August. The program for this workshop has been set, and it will consist of tutorials, paper presentations, and panel sessions focused on computer security incident response and prevention. The Third USENIX UNIX Security Symposium will be held in Baltimore in September. This symposium focuses on tools and techniques to improve the security characteristics of UNIX-based systems. CERT staff have worked with the USENIX Association to develop the technical program, referee proposed papers, and arrange presentations of accepted papers.

To raise the community's awareness of computer security issues, CERT staff were invited speakers at the following events:

- The National Testbed Network Security Conference, held at Falcon AFB in Colorado Springs, Colorado.
- The International Computer Crimes Conference (FBI), attended by representatives of law enforcement agencies from many countries. The CERT presentation provided background information about the Internet, statistics showing the dramatic increase in security incidents, information about the increasing level of sophistication of the intruders, and some data analyzing trends.
- INET '92, sponsored by the Internet Society, focused on the issues of open, international networks. More than 600 people from 70 different countries attended the conference.
- IEEE Symposium on Security and Privacy, focused on an emerging CERT research agenda.

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**Computer Emergency
Response Team**

- British Petroleum America security seminar, attended by corporate representatives interested in learning more about network security and CERT functions.
- Michigan Collegiate Telecommunications Association conference, attended by 100 academics, technicians, and corporate representatives interested in network security and issues related to security incident response.
- Information Technology Association of America conference, attended by more than 6000 developers, many of whom were very interested in security issues.
- Federal Computer Investigators Conference, attended by more than 100 law enforcement agents, focused on computer viruses.

To encourage research targeted at improving the security of open architecture, networked systems, the CERT staff has developed plans for a Security Researcher's Invitational Workshop, to be held at the SEI in November.

• • • • • Software Process Assessment

The Software Process Assessment (SPA) Project helps organizations improve their software development process. It helps organizations by providing a structured method for assessing their current practice, as well as continuously improving the assessment method within a process improvement context. The objectives of the assessment method are to identify key areas for improvement, utilizing the SEI's process maturity model as a framework, and to help the organization initiate those improvements.

During the second quarter of 1992, the SPA Project was involved in the development of the CECOM/Fort Monmouth Assessment Final Report and Recommendations Briefing. A SPA representative attended the briefing of recommendations to CECOM senior management.

In addition, SPA project members were involved extensively in supporting the CMM and SEPG Workshops held in Tysons Corner, Virginia.

In the product development area, project staff completed the development of a comprehensive plan to update the SPA method and associated training to incorporate the concepts of the revised CMM. The updated method will incorporate use of the various questionnaire instruments (currently in development) as well as the CMM, thereby increasing the reliability and consistency of assessments. As part of this effort, SPA project staff continued their participation in an SEI-wide integrated product development effort for all the process products related to the CMM.

• • • • • Improvement Planning and Organizing

The Improvement Planning and Organizing (IPO) function focuses activities with SEI clients who seek long-term support for their software process improvement efforts. IPO was formed to address needs for integrated software process improvement programs that include: understanding the principles of how to effectively launch and sustain continuous software process improvement; and integrating assessments, organizational dynamics, the maturity model, process definitions, and improvement metrics into a plan. IPO members provide support in planning and organizing continuous software process improvement programs including: using business/case histories in software process improvement to illustrate benefits achieved; promoting and launching software process improvement programs; and coordinating clients' activities with the work of different SEI projects.

Staff members supported two current major clients (Air Force Logistics Command (ALC) and the Army Materiel Command (AMC)) in continuing their assessments and improvement efforts. Between these two commands, IPO staff members are supporting 13 different improvement programs.

Staff members co-sponsored, with the Process Program, the Fourth National SEPG Workshop in Tysons Corner, Virginia. In conjunction with this workshop, staff members also sponsored a half-day gathering of SEPGs from throughout the DoD for a first ever cross-DoD exchange of information and activities.

Staff members initiated collaborative efforts with both industry and the DoD to review an early draft of an improvement roadmap and to gather feedback on how it applies to both domains. This early piloting effort will continue throughout the remainder of 1992.

The Organization Capability Development (OCD) function supports SEI clients' software process improvement efforts by helping the client organizations develop the capability to manage the organizational aspects of improvement at their sites. Services include organizational assessment, vision setting and dissemination, strategic planning, transition infrastructure development, executive consulting, cross-functional team development, managing technological change, and consulting skills for software engineering process groups. The goal of the function is to provide to clients the self-sustaining capability of managing their own long-term improvement.

Staff members delivered to Computer Resources and Technology Transition Program at Hanscom AFB a strategy for the transition of the Managing Technological Change course to the SEI client base in the Air Force.

The Managing Technological Change course was taught at the SEI and in a public offering.

The Consulting Skills Workshop was taught to staff from the Embedded Computer Resources Support Improvement Program (ESIP), the Air Force SSC, and the SEI.

Consulting work continued with the AMC, ALC, and the Air Force SSC.

OCD staff, along with Transition Models staff, drafted a paper ("Foundations for Systematic Software Technology Transition") for the *SEI Technical Review '92*.

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**Organization
Capability
Development**

SEI Products

With the goal of helping end-users help themselves, SEI Products works with other groups in the SEI to develop an integrated set of products and services for managers, practitioners, and educators. SEI Products ensures that the results of SEI work are in a form that the software community can easily and effectively use to improve software practice and that educators can use to improve software engineering.

The Academic Education Project focuses on the long-term development of a highly qualified work force. The project promotes and accelerates the development of software engineering as an academic discipline. The project is developing model curricula and promoting the establishment and growth of software engineering programs, as well as working to increase the amount of software engineering content in computer science programs. The project produces educational materials that support the teaching of software engineering in universities.

• • • • • Academic Education • • • • •

Project staff supported DARPA by reviewing proposals from educators for grants to improve the teaching of software engineering. In a joint program of DARPA and the Ada Joint Program Office, institutions can receive grant money to create new course sequences in software engineering, or to modify or create courses using Ada as the programming language.

The Continuing Education Project interacts with industry and government to increase the availability of high-quality educational opportunities for software practitioners and executives. The project produces the Continuing Education Series and the Technology Series. The Continuing Education Series provides video-based courses designed for clients' in-house education, and executive offerings designed for decision makers involved in improvement efforts. The Technology Series provides stand-alone presentations that promote awareness of emerging issues and leading-edge technologies.

• • • • • Continuing Education • • • • •

This quarter the project presented an executive seminar from the Continuing Education Series at the Washington office of the SEI. Twenty-seven people attended Software Quality Improvement on 22-24 June.

Project members developed a new Continuing Education Series course for executives. The course is entitled "Software Productivity Improvement." Thirteen executives attended the first offering on 13-15 April.

The video-based practitioner course Software Requirements Engineering was completed this quarter. Instructor training was offered on 11-20 May to 11 students.

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**Software Capability
Evaluation**

The Software Capability Evaluation (SCE) Project helps DoD acquisition organizations evaluate the capability of contractors to develop and maintain software competently. The project is improving and implementing an evaluation method that examines the software process of contractors for use in software-intensive acquisitions.

SCE team training was conducted 7-10 April and 19-22 May. On 16-19 June, team training was conducted at AMC/CECOM at Ft. Monmouth, NJ. This was the first official delivery of the team training at a strategic customer site.

The initial SEI delivery of the SCE Overview Seminar was conducted June 3. This is a one-day offering discussing what SCE is and how the government is currently using the method.

A project member supported members of the DSMC in delivering a module on SCE during the Program Managers Course at DSMC. This module will become a standard part of this course. Also, a CMM project member presented modules containing significant SCE information at the Management of Software Acquisition Course at DSMC.

During this quarter, the SCE Project supported action planning as a response to the findings of the Software Engineering Capability Improvement Working Group, chartered as a result of the General Shulstad visit during the first quarter of 1992. SEI response to the findings was presented to General Shulstad during June.

A project member gave an SCE overview at the Aerospace Industries Association embedded computer software committee meeting held in May in Colorado Springs, Colorado.

A project member also presented a tutorial on SCE in support of Bill Curtis' day-long tutorial on Software Process Improvement delivered at the Software Technology Conference in April in Salt Lake City, Utah.

During April, the SCE Project supported and attended the CMM/SEPG workshop held in Tysons Corner, Virginia.

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**Master of Software
Engineering**

In response to industry's growing demand for skilled software developers, CMU offers a 16-month master's degree program in software engineering. The program is a cooperative effort of the CMU School of Computer Science and the SEI. The core of the program is based on the SEI curriculum recommendations for MSE programs. The MSE Project also produces the Academic Series, a set of video-based graduate-level courses on software engineering.

The project completed the taping of a revised version of Software Design, Creation, and Maintenance for the Academic Series. Robert Firth was the instructor.

Fifteen students have been accepted into the CMU MSE program for the fall.

Customer Relations

Customer Relations accelerates the transition of new software technologies and methods by disseminating information, providing mechanisms for collaboration and technology exchange, and offering customers the opportunity to participate in technical interchange meetings, workshops, and educational offerings.

Customer Relations began a subscription program in January. The program is open to any individual with a U.S. mailing address. Subscribers receive regular publications such as *Bridge*, invitations to selected SEI events (e.g., the annual SEI Symposium), and first notification of SEI course offerings and new technical reports. The fee for subscription is \$100 per individual for each calendar year. The program applies only to industry and academia; government individuals receive the same benefits at no cost through controlled distribution. For more information, see page 31.

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Planning continued throughout this quarter for the SEI Software Engineering Symposium, which will be hosted by the SEI and will take place in Pittsburgh on 15-17 September. An optional day of tutorials is available on 14 September. The symposium will bring together software practitioners, managers, and educators to examine the state of software engineering technology and practice in light of SEI projects and plans. SEI products and services, as well as technical focus areas, will be highlighted this year. Participation is open to U.S. industry, government, and academia. The preliminary program and registration information is now available.

Customer Relations held SEI Visitor's Day on 27 May with 60 representatives from industry, government, and academic organizations in attendance. The next Visitor's Day is scheduled for 4 December. Visitors must pre-register with Customer Relations; walk-ins will not be accepted.

This quarter, one new resident affiliate joined the SEI from the Lockheed Missiles and Space Company, Inc. and two from Pacific Bell. As of 30 June 1992, 20 resident affiliates were working at the SEI. Customer Relations hosted 12 affiliates from industry, 1 from academia, and 7 from the Services and government agencies.

This quarter, one new resident affiliate joined the SEI from the Lockheed Missiles and Space Company, Inc. and two from Pacific Bell. As of 30 June 1992, 20 resident affiliates were working at the SEI. Customer Relations hosted 12 affiliates from industry, 1 from academia, and 7 from the Services and government agencies.

The following organizations sponsored resident affiliates in the second quarter of 1992.

Industry	AT&T Bell Labs
	Boeing
	Computer Sciences Corporation
	GTE Government Systems
	Hughes Aircraft Company
	IBM
	Lockheed Missiles and Space Company, Inc.
	Pacific Bell
	Paramax
	Texas Instruments
Government	
Air Force	Electronic Systems Division
Navy	Coastal Systems Station
	Naval Ocean Systems Command
Army	Communications-Electronics Command
Other DoD	Defense Logistics Agency
	National Security Agency
Academia	Polytechnic University of Madrid (Spain)

For More Information

For information about purchasing SEI publications, contact one of the following organizations:

RAI	Research Access Inc. 3400 Forbes Avenue, Suite 302 Pittsburgh, PA 15213 Telephone: (412) 682-6510 (or toll-free 1-800-685-6510) FAX: (412) 682-6530
NTIS	National Technical Information Service U.S. Department of Commerce Springfield, VA 22161-2103 Telephone: (703) 487-4600
DTIC	Defense Technical Information Center ATTN: FDRA Cameron Station Alexandria, VA 22304-6145 Telephone: (703) 274-7633

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**How to Order SEI
Publications**

For information on the subscriber program and other SEI offerings, contact:

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Pittsburgh, PA 15213-3890
(412) 268-5800
Internet: customer-relations@sei.cmu.edu

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**How to Get Additional
Information**

List of Acronyms

ADARTS	Ada-based design approach for real-time systems	9
AFB	Air Force Base	2
ALC	Air Force Logistics Command	25
AMC	Army Materiel Command	2
AMCCOM	Armament Munitions and Chemical Command	3
AT&T	American Telephone and Telegraph	3
ATCCS	Army Tactical Command and Control System	16
AWG	Architecture Working Group	14
CARDS	Central Archive for Reusable Defense Software	16
CECOM	Communications and Electronics Command	16
CERT	Computer Emergency Response Team	23
CIM	Corporate Information Management	17
CM	Configuration Management	17
CMM	Capability Maturity Model	3
CMU	Carnegie Mellon University	7
CSITE	Combat System Integrated Training Equipment	14
DARPA	Defense Advanced Research Projects Agency	3
DBMS	Database Management System	19
DCL	Development Center at Ft. Lee	16
DoD	Department of Defense	1
DSMC	Defense Science Management College	4
DSSA	Domain-Specific Software Architecture	14
DWG	Dependability Working Group	10
ESD	Electronic Systems Division	16
ESPRIT	European Strategic Programme of Research into Information	4
FODA	Feature-Oriented Domain Analysis	16
GTE	General Telephone and Electronics	17
IPO	Improvement Planning and Organizing	24
JMASS	Joint Modeling And Simulation System	14
LCSEC	Life Cycle Software Engineering Center	3
MBSD	Model-Based Software Development	13
MCC	Microelectronics Computer Technology Corporation	4
MICOM	Missile Command	3
MSE	Masters of Software Engineering	7
MTV	Message Translation and Validation	15
NAWC	Naval Air Warfare Center	2
NGCR	Next Generation Computer Resource	7
NIST	National Institute of Standards and Technology	15
NUICCS	North American Air Defense Command U.S. Space Command Integrated Command and Control Center	16
OCD	Organization Capability Development	25
OCU	Object-Connection Update	14
PRISM	Programmable Reusable Integrated Software Modules	9
PSP	Personal Software Process	19
RMA	Rate Monotonic Analysis	7
RMARTS	Rate Monotonic Analysis for Real-Time Systems	7

SAE	Software Architectures Engineering	13
SAME	SQL Ada Module Extension	19
SCE	Software Capability Evaluation	4
SCM	Software Configuration Management	17
SEPG	Software Engineering Process Group	2
SPA	Software Process Assessment	4
SPC	Software Productivity Consortium	9
SPD	Software Process Definition	2
SQL	Structured Query Language	19
SRG	SQL Rapporteur Group	19
SSC	Standard Systems Center	2
STARS	Software Technology for Adaptable, Reliable Systems	2
SWAP	Software Action Plan	1
TM	Transition Models	14
TO&P	Technical Objectives and Plans	2
TQM	Total Quality Management	4
USTAG	U.S. Technical Advisory Group on Ada	19
WAdaS	Washington Ada Symposium	8
WG9	Working Group 9	19